Manitoba

RURAL DEVELOPMENT
MANITOBA WATER SERVICES BOARD

Water Facts

DUGOUT AND POND AERATION

91-03942/

During winter, ice cover on dugouts prevents water from dissolving atmospheric oxygen. As a result, aerobic decomposition, a process in which dead organic material such as algae, animal and other plant life decay with oxygen, depletes the existing dissolved oxygen in the water.

Once the dissolved oxygen is used, anaerobic decomposition (decay without oxygen) takes place. Carbon dioxide and hydrogen sulfide gases are produced. The hydrogen sulfide, which is odorous, reacts with the organic matter causing the water to become black and odored, tainting the water quality. This is commonly called black dugout water.

The deterioration of water quality in this manner occurs in a number of dugouts and ponds. Even those properly maintained and having a high oxygen content in the fall are likely to have little or no oxygen left by the end of winter. This makes hydrogen sulfide production probable. As well, low oxygen levels in dugout bottoms frequently occur because wind does not effectively mix the water. This too, contributes to water quality deterioration.

Aeration

Maintaining aerobic decomposition in water throughout the year, but especially during winter can be achieved through the periodic diffusion of atmospheric air into the water supply. This process, known as aeration, assures a sufficient level of dissolved oxygen entering the water supply to control odors and maintain good water quality. Aeration should be applied at intervals during the summer to maintain good water quality and reduce algae growth.

NOTE: Chemical treatment for weeds and algae is still required (see "Keeping Your Dugout Clean").

Types of Aeration Systems

There are a number of methods to aerate water, each with varying degrees of effectiveness.

1. **Water circulation:** Water is pumped from the dugout top to the bottom. This method is considered too costly and inefficient. Also, it is impractical for use in winter.
2. **Pumping water into the atmosphere:** Water is pumped into the atmosphere and allowed to fall on the dugout surface. This method also is not considered practical because evaporation results. Additionally, it is expensive and impractical for winter use.
3. **Massive chlorination:** Great amounts of chlorine are added to the water supply to increase oxidation and cause rapid decomposition. This method is costly and not practical in winter. Furthermore, extreme care must be exercised in handling chlorine.

4. **Compressed air aeration:** Diffused air is introduced into the dugout using a small compressor (air pump), a feeder line (from the compressor location to the dugout bottom) and a distribution line (with drilled holes). There are two methods of line installation — deep burial or shallow burial. Both are permanent installations. Temporary systems using farm-type tank mounted air compressors can be used to improve water quality by injecting air into water through an ice hole. However, difficulties in inserting and servicing the airline and maintaining the compressor are encountered. **A permanent aeration line that allows air to be easily added at any time is recommended for all dugouts.**

Deep Burial Aeration Line Installation

Deep burial aeration systems require installation of a 12 mm (½ in.) feeder line to carry the air. The feeder line is buried with the pump suction line about 2.5 m (eight ft.) deep. Deep burial aeration is recommended as the preferred method of aerating dugout water.

A. FULL DUGOUTS

Steps

1. Determine the length of the feeder line (distance from the air compressor to the dugout flat bottom) and distribution lines (see Design Table). The distribution line should lie on the flat bottom area of the dugout (Figure 1).

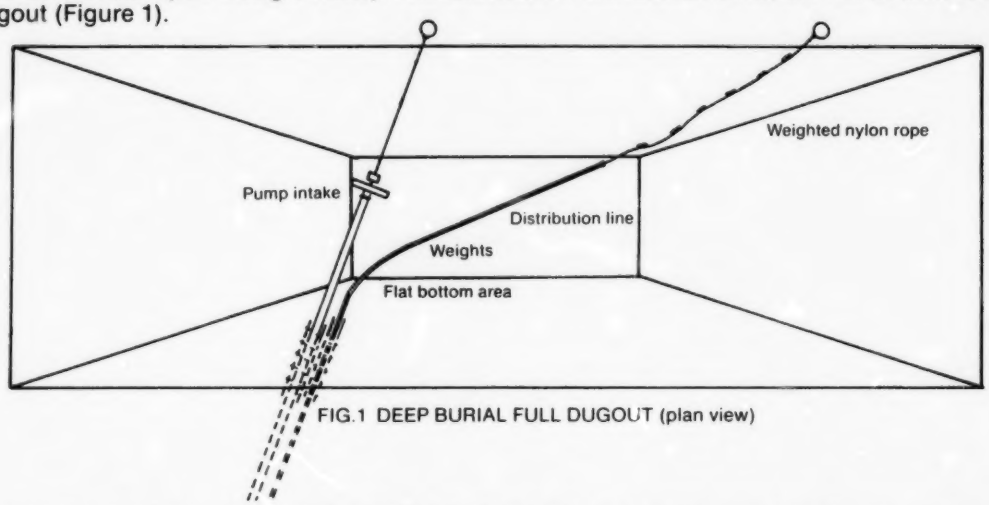


FIG.1 DEEP BURIAL FULL DUGOUT (plan view)

2. Construct concrete weight. (SEE NOTE BELOW ABOUT ALTERNATE WEIGHTS). A one litre milk carton half filled with concrete will result in a one kg (2.2 lb.) weight. Submerge one end of a 1.2 m (four ft.) nylon twine or coated wire that is knotted and tied to a washer into the wet concrete. The other end of the wire (AFTER CONCRETE HARDENS) is tied to the polyethylene pipe and clamped, using stainless steel clamps (Figure 2). Allow 1.0 m (three ft.) between weight and pipe. Weights are attached every two m (six ft.) as shown in Figure 3 using stainless steel clamps.

   NOTE: Scrap iron weights are not recommended as their irregular shape may catch in mud or on the floating intake. Scrap iron weight will not be close to the recommended weight and could result in the air line either lifting or sinking into the mud. Rusting will also occur.

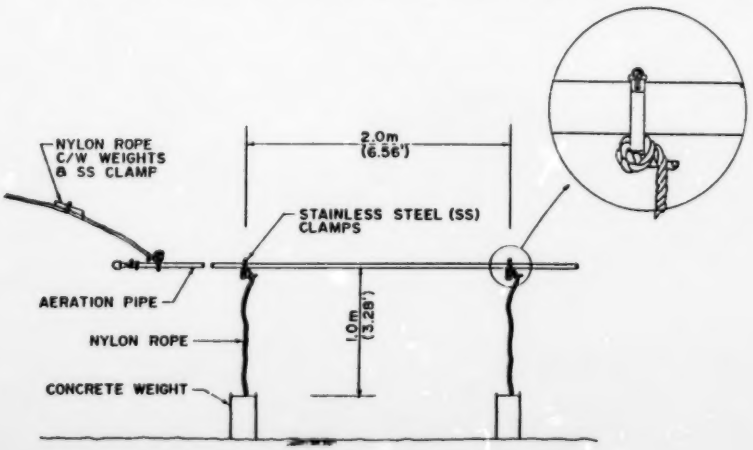


FIG. 2 CONCRETE WEIGHT

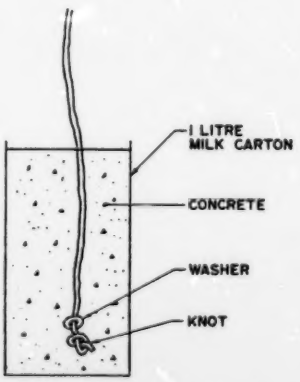


FIG. 3 WEIGHT ATTACHMENT

3. The feeder line, made of 12 mm (.5 in.) polyethylene pipe is placed parallel (no cross-overs) to the pump suction line in the trench to the dugout edge.

4. Protective casing should be installed at the dugout edge. To do this, thread the feeder line through six m (20 ft.) of 25 mm (one in.) diameter polyethylene pipe. Tie areation line protective casing to the suction line protective casing (see **Floating Intakes for Dugouts and Ponds**).

5. Backfill cautiously and install the floating intake.

6. Select a compressor using the Design Table; drill 1.6 mm (1/16 in.) holes according to recommended spacing. Plug the end of the distribution line.

7. Attach the installation rope — eight mm (5/16 in.) nylon — by clamping it to the end of the distribution line. Attach small weights to prevent the rope from floating or being caught in ice. Tape steel rebar or 12 mm x 75 mm (.5 in. x three in.) galvanized pipe for the weights.

8. Start the compressor, if available. Pull the remaining feeder and distribution lines into position. The distribution line should not interfere with the dugout float operation.

9. Slacken the rope and tie it to a permanent post on shore.

10. Please note that a check valve must be installed at the compressor. The check valve should be a spring loaded, all position type, capable of sealing at very low back pressure. An example of an acceptable type is Ocean BT 500.

Shallow Burial Aeration Line Installations

The shallow burial method requires positioning the feeder line about 300 mm (one ft.) below ground to prevent pipe damage. A check valve is placed on the feeder line near the flat bottom area of the dugout to prevent water backing up into the feeder line and freezing. Normally, this system is used where trenching is not required since a water distribution system already exists. Check valve failure and/or condensation in the feeder line (see Shallow Burial Air Compressor Operation) can result in ice blockage of the feeder line during winter.

Steps

1. Determine the length of the feeder line (distance from air compressor to flat bottom area of dugout) and distribution lines (use Design Table). The distribution line must be located on the flat bottom area of the dugout.

2. Construct concrete weights (see step 2, Dugout Deep Burial Installation).

3. To prevent pipe damage, bury the feeder line a minimum of 300 mm (one ft.)

4. Select a compressor. Drill 1.6 mm (1/16 in.) holes according to recommended spacing, and plug the end of the distribution line.

5. Attach the installation rope (see step 8, Dugout Deep Burial Installation).

6. Install a check valve in deep water below the maximum winter ice level. (Ice can reach 1 m (three ft.) in thickness. The check valve should be a spring loaded, all position type capable of sealing at very low back pressure. An example of an acceptable valve is the Ocean BT 500.

7. Start the compressor. Pull the remaining feeder and distribution lines into position. The rope will pass under the floating intake rope. The distribution line should not interfere with the operation of the dugout float (Figure 4).

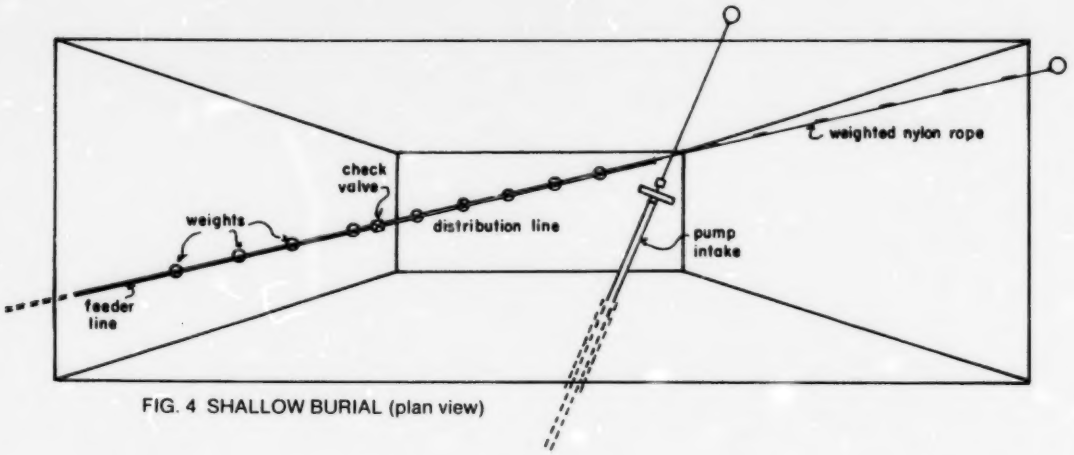


FIG. 4 SHALLOW BURIAL (plan view)

8. Slacken the rope and tie it to a permanent post on shore (Figure 5).

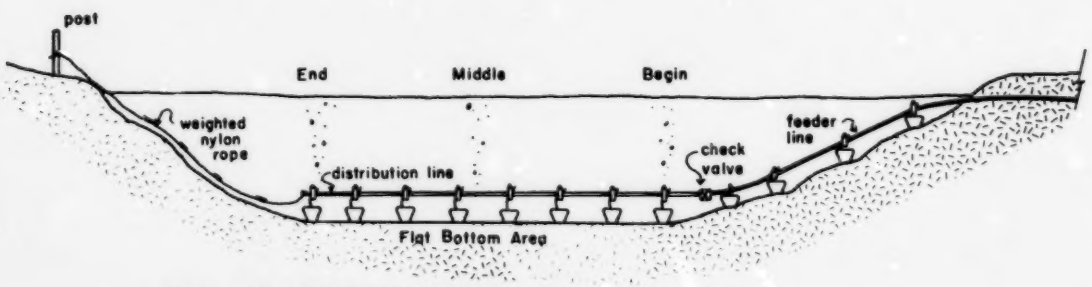


FIG. 5 SHALLOW BURIAL (side view)

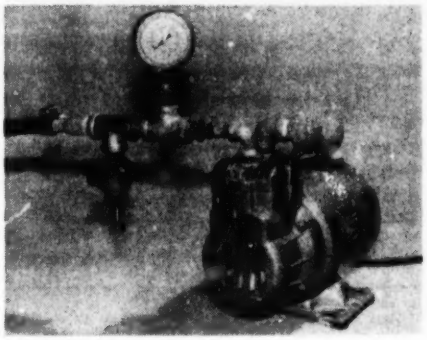
Air Compressor Selection

Two types of compressors are used to power aeration systems: oil or oil-less.

1. **Oil** — Farm-type oil compressors can be used. However, since most are not designed for constant operation, they are not recommended. As well, crankcase oil level requires constant monitoring and noise levels are excessive if installed in occupied premises. Small amounts of oil may spill into the water supply and readjustment of the pressure switch on tank mounted units is necessary to avoid frequent start-ups which reduce motor life.

   When installing oil compressors do not directly connect polyethylene pipe since heat build-up will burst the pipe. Galvanized or copper piping is used to the outdoors to dissipate the heat.

2. **Oil-less** — Piston or diaphram oil-less compressors are recommended for aeration systems. However, not ali diaphram air compressors are designed for continuous operation. Compressors under 0.25 kW (0.33 hp) are normally quiet enough for household operation, but diaphram units are usually the most quiet. They are less costly and easily serviced (replace diaphram) in comparison to piston unit (replacing rings and valves). However, diaphram units are not recommended for use in unheated areas (temperature under 5°C).



A pressure gauge placed on the discharge side of the compressor is recommended for monitoring the compressor and aeration distribution system operation using oil or oil-less types. Installing a pressure relief valve is recommended to prevent excessive pressure build-up if a malfunction occurs.

NOTE: Noise levels of larger units may be reduced by connecting the compressor intake to the outside.

Shallow Burial Air Compressor Operation

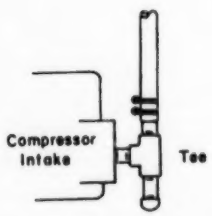


FIG. 6 COMPRESSOR SUCTION CONNECTION (side view)

Care should be taken to install compressor units in a dry area. Installation in heated high moisture areas (i.e. laundry room) can result in freezing problems because of the condensation of warm, moist air in the cold feeder line. This can be minimized by connecting the air intake pipe to the outside. Otherwise, the moisture collects and freezes at some point in the feeder line, gradually blocking the pipe. Turn the outside air intake pipe downward to prevent entry of rain or snow. A tee acting as a trap, should be placed at the compressor pump head.

Notes on Aeration System Operation

- Aeration systems should be controlled by an automatic timer capable of skipping selected days. The recommended schedule shown in the Design Table is a guide for compressor operation on a clean, well maintainted dugout.
- If satisfactory results are not obtained based on the recommended hours of operation, or if the dugout has a high organic content, the hours of operation should be increased.
- Operating the compressor intermittently for eight consecutive hours once a week during the summer will circulate water bringing oxygenated surface water to the dugout bottom. Water circulation disturbs algae, reducing algae production. Chemical treatment for algae is still required, however.
- Installing a permanent aeration system in the above manner is a cheap method of ensuring a high quality water source at all times of the year.

WARNING: Ice covering aerated dugouts or ponds is not safe in winter. Post signs warning of unsafe conditions and to prohibit snowmobile traffic on the ice.

DESIGN TABLE

Size of Dugout (length x width x depth)		Minimum Compressor Airflow @ 70 kPa (10 psi)		Length Distribution Line (on flat bottom part of dugout only)		Number of 1.6 mm (1/16 in.) Holes Spaced 0.5 m (18 in.) Apart in Distribution Line Figure 7 (1)				Recommended Minimum Compressor Operations From Dec. to May (2, 3)
m	ft.	m^3/hr	cfm	m	ft.	beginning	middle	end	total	
50x20x4.3	165x65x14	1.7	1	15	50	2	2	3	7	6 hr period twice/wk
60x21x4.3	200x70x14	1.7-2.5	1-1.5	15	50	2	2	4	8	6 hr period twice/wk
90x37x6	300x120x20	5	3	40	130	4	5	7	16	6 hr period every day
90x60x6	300x200x20	8.5	5	40	130	6	7	11	24	6 hr period every day

Notes:

(1) One hole will pass approximately 0.4 m^3/hr (0.25 ft^3/min) of air.

(2) Times are approximate and serve as a guide only.

(3) Periodic aeration recommended for 48 continuous hours once a month during summer to discourage algae growth.

(4) 12 mm (½ in.) feeder line should not exceed 300 m (1000 ft.)

METRIC CONVERSIONS

NOMINAL PIPE DIA.

mm	in.
3	1/8
6	1/4
10	3/8
12	1/2
20	3/4
25	1
32	1 1/4
40	1 1/2
50	2
75	3
100	4
150	6
200	8

FLOWS

1 Imp. gal. = 4.546 L
1 U.S. gal. = 3.785 L

DIMENSIONS

1 in. = 25.4 mm
= 2.54 cm
1 ft. = 0.3048 m
3.28 ft. = 1 m

WEIGHTS

1 oz. = 28.35 g
1 lb. = 0.4536 kg
2.2 lb. = 1 kg

PRESSURE

1 psi = 6.895 kPa

POWER

1 hp. = 0.7457 kW
1 kW = 1.34 hp.

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